

Homework #0

Due in class, next lesson.

1. Read Edwards & Syphers chapter 1.
2. Show that the total energy for a head-on collision of two particles each with a center of mass energy $mc^2\gamma_{\text{cm}}$ is equivalent to a fixed target collision at a laboratory energy of γ , where

$$\gamma = 2\gamma_{\text{cm}}^2 - 1 \quad (1)$$

3. In one dimension the work done by a force F acting through a distance ds is $dE = F ds$. Show *directly* that the energy gain of a particle of mass m when its Lorentz factor increases by $\Delta\gamma$ is

$$\Delta E = \Delta\gamma mc^2 \quad (2)$$

where the rest energy of the particle is $E_0 = mc^2$. From this it follows that $E = E_0\gamma$. Use this result to show that

$$E^2 = p^2c^2 + m^2c^4 \quad (3)$$

4. Show that the incremental increase in energy dE is related to the incremental increase in momentum dp through

$$\frac{dE}{E} = \beta^2 \frac{dp}{p} \quad (4)$$

5. A singly charged particle of momentum p travels through a constant magnetic field B , and is bent in the arc of a circle of radius ρ . Show that the *magnetic rigidity*

$$B\rho [\text{Tm}] = 3.3357 p[\text{GeV}/c] \quad (5)$$